

Various modifications can be made to the present invention without departing from the apparent scope hereof.

WE CLAIM:

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1. An intravascular tubular member for use in treatment of an injured artery that conveys blood flow from a proximal arterial region proximal to the injured artery to one or more distal arterial vessels and is introduced in a nondeployed state with a smaller nondeployed diameter using a minimally invasive vascular access through an artery that supplies blood to or receives blood from the injured artery and expands upon deployment to a larger radially deployed diameter and is implanted in a fully deployed state, said intravascular tubular member comprising;

A. a proximal tubular section with an inlet end to provide passage for blood flow into said intravascular tubular member from the proximal arterial region;

B. one or more distal tubular sections, each of said one or more distal tubular sections having an outlet end to provide passage of blood flow out of said intravascular tubular member to one or more distal arterial vessels;

C. an intravascular tubular member wall extending between said inlet end of said proximal tubular section and said outlet end of each of said one or more distal tubular sections;

D. one or more folded tubular sections, each of said one or more folded tubular sections having an upstream end and a downstream end, said upstream end of each of said one or more folded tubular sections being joined to said proximal tubular section and said downstream end of each of said one or more folded tubular sections being joined to one of said one or more distal tubular sections, each of said one or more folded tubular sections having said intravascular tubular member wall folded back and forth upon itself forming an inner wall, a center wall, and an outer wall;

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whereby said intravascular tubular member can extend in an axial length from said inlet end to said outlet end during the deployment from the nondeployed state to the fully deployed state.

2. An intravascular tubular member for use in treatment of an injured artery that conveys blood flow from a proximal arterial region proximal to the injured artery to one or more distal arterial vessels and is introduced in a nondeployed state with a smaller nondeployed diameter using a minimally invasive vascular access through an artery that supplies blood to or receives blood from the injured artery and expands upon deployment to a larger radially deployed diameter and is implanted in a fully deployed state, said intravascular tubular member comprising;

A. a proximal tubular section with an inlet end to provide passage for blood flow into said intravascular tubular member from the proximal arterial region;

B. one or more distal tubular sections, each of said one or more distal tubular sections having an outlet end to provide passage of blood flow out of said intravascular tubular member to one or more distal arterial vessels;

C. an inner surface and an outer surface of said intravascular tubular member between said inlet end of said proximal tubular section and said outlet end of each of said one or more distal tubular sections;

D. one or more folded tubular sections, each of said one or more folded tubular sections having an upstream end and a downstream end, said upstream end of each of said one or more folded tubular sections being joined to said proximal tubular section and said downstream end of each of said one or more folded tubular sections being joined to each of said one or more distal tubular sections, each of said one or more folded tubular sections having a first portion of said inner surface in apposition with a second portion of said inner surface and a proximal portion of said outer surface in apposition with a distal portion of said outer surface;

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whereby said intravascular tubular member can extend in an axial length from said inlet end to said outlet end during the deployment from the nondeployed state to the fully deployed state.

3. An intravascular tubular member for implantable use within a human body for treatment of abdominal aortic aneurysm that conveys blood flow from a proximal aortic region proximal to an injured artery to one or more distal arterial vessels and is introduced in a nondeployed state with a smaller nondeployed insertion diameter using a minimally invasive vascular access through an artery that supplies blood to or receives blood from the aorta and expands upon deployment to a larger deployed diameter and is implanted within the human body in an implanted state, said intravascular tubular member comprising;

A. a proximal tubular section having an inlet end to provide passage for blood flow into said proximal tubular section from the proximal aorta, said proximal tubular section being joined to at least one folded tubular section, said at least one folded tubular section providing for a change in axial length for said intravascular tubular member, each of said at least one folded tubular section being joined to a distal tubular section, said distal tubular section having an outlet end to provide for passage of blood flow out of said distal tubular section into the one or more distal arterial vessels;

B. said at least one folded tubular section being folded back and forth upon itself whereby said at least one folded tubular section can be unfolded during deployment from the nondeployed state to the implanted state to provide an increase in length of said at least one folded tubular section.

4. The intravascular tubular member of claim 1 for use in the treatment of abdominal aortic aneurysm wherein;

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A. said one or more distal tubular sections comprise two distal tubular sections, each of said two distal tubular sections having an outlet end to provide passage of blood flow out of said intravascular tubular member to two distal arterial vessels;

B. said one or more folded tubular sections comprise two folded tubular sections, each of said two folded tubular sections having an upstream end and a downstream end, said upstream end of each of said two folded tubular sections being joined to said proximal tubular section and said downstream end of each of said two folded tubular sections being joined to one of said two distal tubular sections, each of said two folded tubular sections having said intravascular tubular member wall folded back and forth upon itself forming an inner wall, a center wall, and an outer wall;

C. said intravascular tubular member further comprising an attachment means positioned at said inlet end to hold said intravascular tubular member into contact with the proximal arterial region;

5. The intravascular tubular member of claim 4 further comprising an attachment means positioned at said outlet end of each of said two distal sections to hold said intravascular tubular member into contact with the two distal arterial vessels.

6. The intravascular tubular member of claim 1 for use in the treatment of an arterial injury in a blood vessel not located near a bifurcation wherein;

A. said one or more distal tubular sections comprises one distal tubular sections, said one distal tubular sections having an outlet end to provide passage of blood flow out of said intravascular tubular member to one distal arterial vessel;

B. said one or more folded tubular sections comprise one folded tubular section, said one folded tubular sections having an upstream end and a downstream end, said upstream end of said one folded tubular sections being joined to said proximal tubular section and said downstream end of said one folded tubular section being joined to said

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one distal tubular section, said folded tubular section having said intravascular tubular member wall folded back and forth upon itself forming an inner wall, a center wall, and an outer wall;

C. said intravascular tubular member further comprising an attachment means positioned at said inlet end to hold said intravascular tubular member into contact with the proximal arterial region;

7. The intravascular tubular member of claim 1 wherein a bonding agent is placed between said center wall and said outer wall.

8. The intravascular tubular member of claim 2 wherein a bonding agent is placed between said proximal portion of said outer surface and said distal portion of said outer surface.

9. The intravascular tubular member of claim 1 wherein one or more holding pins are placed in said one or more folded tubular sections in a deployed state.

10. An attachment anchor for attaching an intravascular tubular member within a blood vessel and applying an outward expansion force against the blood vessel in a deployed state, said attachment anchor being delivered in the nondeployed state with a smaller nondeployed diameter and able to undergo an expansion deformation to a deployed state with a larger deployed diameter for implantation, said attachment anchor comprising;

A. a plurality of nodes and struts connected to each other to form a ring structure with a cylindrical shape, said attachment anchor being comprised entirely of nodes and struts, said attachment anchor having a uniformly curved cylindrical surface;

B. each of said nodes being comprised of at least one hinge and at least two transition regions, each of said transition regions being joined to a strut;

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C. said hinge having a hinge width, a hinge length, and a hinge radial dimension which do not allow said hinge to bend in a radial direction due to a crush deformation and which allow said hinge to bend within the uniformly curved cylindrical surface of said attachment anchor due to the expansion deformation and provide said attachment anchor in the deployed state with the expansion force against the blood vessel wall,

D. each of said struts having a strut width, a strut length, and a strut radial dimension which do not allow said struts to bend in the uniformly curved cylindrical surface of the attachment anchor, and which allow said struts to bend in the radial direction due to crush deformation and provide said attachment anchor in a deployed state with a crush elastic bending force,

whereby said attachment anchor provides an uncoupling of the expansion force of said hinge from the crush elastic bending force of said strut such that these forces can be varied independently from one another.

11. An attachment anchor for attaching an intravascular tubular member within a blood vessel and applying an outward expansion force against the blood vessel in a deployed state, said attachment anchor being delivered in the nondeployed state with a smaller nondeployed diameter and able to undergo an expansion deformation to a deployed state with a larger deployed diameter for implantation, said attachment anchor comprising;

A. a plurality of nodes and struts connected to each other to form a ring structure with a cylindrical shape, said attachment anchor being comprised entirely of nodes and struts;

B. each of said nodes having at least one hinge and at least two transition regions, each of said transition regions being joined to a strut;

C. said hinge having a hinge width, a hinge length, and a hinge radial dimension which do not allow said hinge to bend in a radial direction due to a crush deformation and which allow said hinge to bend in the direction of the hinge width due to the

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expansion deformation and provide said attachment anchor in the deployed state with the expansion force against the blood vessel wall,

D. each of said struts having a strut width, a strut length, and a strut radial dimension which do not allow said struts to bend in the direction of the strut width, and which allow said struts to bend in the radial direction due to crush deformation and provide said attachment anchor in a deployed state with a crush elastic bending force,

whereby said attachment anchor provides an uncoupling of the expansion force of said hinge from the crush elastic bending force of said strut such that these forces can be varied independently from one another.

12. The attachment anchor of claim 10 wherein said plurality of nodes and struts are arranged in series with each of said struts being joined to two of said nodes and each of said nodes being joined to two of said struts.

13. The attachment anchor of claim 10 wherein said plurality of nodes and struts are arranged to form a closed configuration.

14. The attachment anchor of claim 10 wherein said strut radial dimension, said strut width, and said strut length provide said strut with an ability to bend in a radial direction due to crush deformation without affecting the expansion deformation of the attachment anchor in a deployed state, the expansion deformation being controlled by said hinge width, said hinge length, and said hinge radial dimension of said hinge.

15. The attachment anchor of claim 10 wherein said hinge has a plastic deformation as said attachment anchor undergoes the expansion deformation.

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16. The attachment anchor of claim 10 wherein said hinge has an elastic deformation as said attachment anchor undergoes the expansion deformation.
17. The attachment anchor of claim 10 wherein at least one of said nodes comprises a barb.
18. The attachment anchor of claim 17 wherein said barb is held in a folded conformation by said nodes or struts in a nondeployed state and is released by said nodes or struts such that said barb extends outward to its fullest extent upon the attachment anchor undergoing an expansion deformation to a specific deployment angle.
19. The attachment anchor of claim 1 wherein said attachment anchor has intranasal openings that provide attachment sites for securing said attachment anchor to an intravascular tubular member.
20. A vascular tubular member comprised of polymeric multifilament strands and metallic monofilament strands woven along with each other in a generally circumferential direction and comprising at least multifilament polymeric strands woven in the axial direction, said metallic strands woven in a generally circumferential direction providing optimal outward expansion force for a thin wall thickness and provide for kink resistance, said multifilament polymeric strands providing for sealing at crossover points.
21. A vascular tubular member comprised of polymeric multifilament strands and metallic monofilament strands woven along with each other in a generally axial direction and comprising at least multifilament polymeric strands woven in the

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circumferential direction, said metallic strands woven in a generally axial direction providing optimal axial compressive strength for a thin wall thickness, said multifilament polymeric strands providing for sealing at crossover points.

22. The vascular tubular member of claim 20 wherein metallic monofilament strands are woven along with said polymeric multifilament strands in the axial direction, said axially directed metallic strands providing a resistance to axially compressive forces.

23. The vascular tubular member of claim 22 wherein said polymeric multifilament strands and said metallic monofilament strands are double woven at a metal to metal crossover point thereby preventing a leakage site to form at said metal to metal crossover point.

24. The vascular tubular member of claim 20 wherein said polymeric multifilament strands are formed from curved filaments.

25. The vascular tubular member of claim 24 wherein said metallic monofilament strands are curved strands.

26. The vascular tubular member of claim 20 wherein said polymeric multifilament strands are formed from a polymer taken from the group which includes expanded polytetrafluoroethylene, polyester, and polyurethane.

27. The vascular tubular member of claim 21 for intravascular use within a blood vessel wherein at least a fractional number of said metallic monofilament strands extend proximally beyond an inlet end of the vascular tubular member and are attached to an attachment means that is positioned at a distance away and proximal to the said inlet

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end, said vascular tubular member being attached to the blood vessel remote from the attachment means.

28. A vascular tubular member comprised of woven expanded polytetrafluoroethylene multifilament strands in a generally axial and generally circumferential direction, said expanded polytetrafluoroethylene multifilament strands providing for resistance to leakage at crossover points, and said woven structure providing for safety due to a resistance to tear propagation.

29. The vascular tubular member of claim 28 wherein said expanded polytetrafluoroethylene multifilament strands woven in the axial direction are comprised of expanded polytetrafluoroethylene filaments, said expanded polytetrafluoroethylene filaments being comprised of polytetrafluoroethylene microfilaments having a curved structure to provide a stretch characteristic to said expanded polytetrafluoroethylene multifilament strands, to provide the vascular tubular member with kink resistance, and to provide compliance to the vascular tubular member.

30. The vascular tubular member of claim 28 wherein said expanded polytetrafluoroethylene multifilament strands woven in the circumferential direction are comprised of expanded polytetrafluoroethylene filaments, said expanded polytetrafluoroethylene filaments being comprised of polytetrafluoroethylene microfilaments having a curved structure to provide a stretch characteristic to said expanded polytetrafluoroethylene multifilament strands, to provide the vascular tubular member with kink resistance, and to provide compliance to the vascular tubular member.

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31. The vascular tubular member of claim 28 wherein said expanded polytetrafluoroethylene multifilament strands woven in the axial direction and circumferential direction are comprised of expanded polytetrafluoroethylene filaments, said expanded polytetrafluoroethylene filaments being comprised of polytetrafluoroethylene microfilaments having a curved structure to provide a stretch characteristic to said expanded polytetrafluoroethylene multifilament strands, to provide the vascular tubular member with kink resistance, and to provide compliance to the vascular tubular member.

32. The vascular tubular member of claim 28 wherein metallic strands are woven along with said expanded polytetrafluoroethylene multifilament strands in the generally circumferential direction.

33. The vascular tubular member of claim 28 comprising metallic strands woven along with said expanded polytetrafluoroethylene multifilament strands in the generally axial direction.

34. The vascular tubular member of claim 33 further comprising metallic strands woven along with said expanded polytetrafluoroethylene multifilament strands in the generally circumferential direction.

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